***Competency* 2.4 Personnel shall demonstrate knowledge of the requirements documents for radiological control practices, procedures, and limits.**

1. SUPPORTING KNOWLEDGE AND/OR SKILLS

a. Discuss the purpose of 10 CFR 835.

b. Referring to DOE/EH0256-T (Revision 1), *Radiological Control Manual*, locate and discuss the following requirements:

- Access training
- Dose limits
- Posting types and use
- Access Requirements

2. SUMMARY

DOE has the responsibility to establish radiation protection standards that are consistent with guidance developed by several interagency committees under the leadership of the Environmental Protection Agency (EPA). This guidance, approved by the President, is based on recommendations put forth by four principal scientific committees: the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the Committee on the Biological Effects of Radiation (BEIR).

10 CFR Part 835, *Occupational Radiation Protection*, implements the EPA *Radiation Protection Guidance to the Federal Agencies for Occupational Exposure* (52 FR 2822) and codifies existing DOE radiation protection directives as they apply to occupationally exposed workers at its facilities. The final rule became effective 30 days after its publication on Dec. 14, 1993, in the *Federal Register*. This regulation establishes requirements for radiation protection of occupational workers at DOE facilities with the intent of ensuring that radiation exposures are kept not only within applicable limits, but as far below these limits as is reasonably achievable.

Codification of the existing directives provides the basis for assessment of civil and criminal penalties (under the Price-Anderson Amendments Act) for violations of nuclear safety requirements found in the final rule. One of the most important impacts of 10 CFR 835, therefore, is that the enforcement power of DOE is greatly enhanced.

The requirements in 10 CFR 835 are mandatory. Compliance with published guides in support of 10 CFR 835, such as the Implementation Guides, or guidance documents such as the *Radiological Control Manual*, is not required unless committed to by the facility in their contractual agreement. One of the most important requirements in 10 CFR 835 is that facilities have a documented radiation protection program (RPP) approved by DOE. The RPP is used by DOE auditors to assess compliance.

There are some areas related to radiation protection of workers that are not included in 10 CFR 835. For this reason, the Department has issued Notice 441.1, *Radiological Protection for DOE Activities*. This notice consists of a series of performance-based requirements designed to supplement and augment the requirements of 10 CFR 835. In DOE's view, the combination of N441.1, 10 CFR 835, and available implementation guidance forms the basis for a strong radiological protection program.

The *Radiological Control Manual* offers detailed guidance for implementation of radiation protection in the DOE system. It establishes practices for the conduct of DOE radiological control activities and states DOE's positions and views on the best courses of action currently available in the area of radiological controls. This manual is intended to be reissued as a technical standard. The use of "shall" statements presently in the document will presumably be changed to "should" (or equivalent) statements. For the purposes of this competency, statements referenced from the *Radiological Control Manual* employing the word "shall" have been modified to "should" or similar wording to reflect the shift in emphasis from a regulatory-based document to a guidance document.

3. SELF-STUDY SCENARIOS/ACTIVITIES AND SOLUTIONS

NOTE: The reference below was used to create the following scenario.

- U.S. Department of Energy. (1996). *Operating Experience Weekly Summary (96-17,* April April 19-25, 1996, Final Report Number 1). Washington, D.C., Office of Nuclear and Facility Safety.

Scenario 1, Part A

On July 31, two workers employed at a DOE contractor facility were tasked with installing a new process line in an indoor building posted and controlled as a high radiation and high contamination area. This activity was infrequently performed. Both workers had completed Radiological Worker I training and additional training to allow them access into high radiation areas. Both workers were currently in compliance with 10 CFR 835 training requirements. However, one worker (Worker "A") required retraining effective the first day of the following month. The workers had been issued and had signed a Radiation Work Permit (RWP) limiting the scope of work to installing the new line in a shielded area of the building. The RWP required a full set of protective clothing without respiratory protection based on the scope and location of the work. Personnel dosimetry requirements consisted of a pocket ionization chamber (0 to 200 mR scale) and a thermoluminescent dosimeter (TLD) badge.

The workers entered the area and began installing new pipe. Operations continued smoothly until late in the afternoon when the workers discovered an out-of-service drain line interfering with installation of the new line. Unfortunately, they failed to observe a faded "Caution: Radioactive Materials" posting placed on the drain line. Because of the time, they decided to quit for the day.

The following morning, the workers informed their supervisor of the situation. The supervisor determined that work could not continue until a flanged pipe tee, connected to the drain line, was removed. Worker "A" attempted to remove the pipe tee, but, having difficulty loosening it, asked for assistance from Worker "B." After five minutes and considerable effort, the tee was successfully removed. Worker "B" observed that one of his gloves had been badly torn during this process, so he removed it and left it on the floor. He then spent a couple of minutes closely examining, touching, and measuring the end of the drain in order to locate a cap that would fit the exposed opening. Not finding an appropriate match, he decided to leave the end open. The two workers spent the following ten minutes one foot away from the old drain line while connecting another section of the new process line. After installation was completed, the workers departed the work area, removed their protective clothing, and performed whole-body frisking. Worker "A" was free of contamination; Worker "B" found contamination on his hands. A radiological control technician (RCT) was notified.

Identify and discuss those portions of the scenario that address access training, dose limits, posting types and use, and access requirements. Your response should be based on recommendations found in the *Radiological Control Manual.*

Scenario 1, Part B

Following decontamination of Worker "B's" hand, the RCT performed a survey near the drain line. His instrumentation indicated a whole-body dose equivalent rate of 60 millirem per hour (mrem/hr) at a distance of 30 centimeters.

What concern specifically regarding posting is raised in this scenario? Use the DOE *Radiological Control Manual* to assist you.

Estimate the whole body dose equivalent (mrem) received by Workers "A" and "B" due to external exposure from the out-of-service drain line only.

NOTE: To aid you in your calculation, assume that the workers maintained a constant one- foot distance from the drain line and

- Each worker initially spent five minutes at the drain line discussing what to do about the pipe tee obstruction interfering with their work.
- Each worker spent five minutes attempting to remove the flanged pipe tee.
- Worker "B" spent an additional two minutes examining the exposed drain opening.
- Each worker spent 10 minutes next to the drain line connecting another section of the new process line.

What is the significance of the reported external doses in terms of DOE limits? (Reference the *Radiological Control Manual* in your response.)

Scenario 1, Part A Solution

The scenario as presented raises several points related to access training and requirements, dose limits, and postings. These include:

- Assigning either worker to this task considering the entrance to the building was posted as a high radiation and high contamination area. A higher level of training is typically recommended for entry into these areas. In addition, Worker "A" required retraining. Even if this individual had the requisite training for entry into these areas, he should not have received authorization to reenter the area on the first day of the month.
- The faded radioactive materials posting that, if observed by the workers, could have alerted them and conceivably led to a minimization of the dose received.
- Article 334 addresses the minimum recommendations for unescorted entry into a high radiation area. Four criteria should be met: completion of Rad Worker II training (with one exception noted in Article 632.5), training in the use of a survey meter, signatures on the RWP, and the use of personnel and supplemental dosimetry. Note that the two workers had completed Rad Worker I and additional training for access into high radiation areas. This additional training satisfies the first condition of Article 334. Both workers had signed the RWP. The workers had presumably been trained in the use of a survey meter, but no survey instruments were carried into the area and no surveys were ever performed. The workers carried personnel dosimetry, but no supplemental dosimetry.

  NOTE: Some consideration could conceivably be given to the fact that even though the door to the building was posted as a high radiation and high contamination area, the work took place in a part of the building where a radiation area existed. The workers did meet the requirements for work in a radiation area. Even so, Worker "A" should not have been allowed access the following day.
- Recommendations for unescorted access into high contamination areas include Radiological Worker II training (no exceptions are given), signatures on the RWP, protective clothing and respiratory protection when specified on the RWP, prejob briefings, and personnel dosimetry. Examining these five recommendations, the workers should not have been allowed access into the building because they had not completed Rad Worker II training. No prejob briefing had occurred.
- Articles 631-633 discuss the Radiological Worker Training requirements for access to radiological areas.

- Article 641 advocates that training not only stress normal or routine operations, but also situations where radiological conditions change during the course of performing a particular work function. Dose rates, for example, could increase as the job proceeds, underscoring the importance of recognizing, evaluating, and anticipating changing conditions that could affect a worker's exposure. Training requirements for radiological control technicians and supervisors are specified in Articles 642-644.

According to Article 231, postings should "alert personnel to the presence of radiation and radioactive materials," "be conspicuously posted and clearly worded," and "be maintained in a legible condition." The worker's failure to observe the posting is clearly not entirely their fault, but likely resulted in receiving a higher dose.

The reading of 60 mrem/hr at 30 cm qualifies as a radiation area as noted in Table 2-3, Criteria for Posting Radiation Areas. Posting the drain line as a radiation area should have been performed under Article 234.

Calculating the external whole body dose equivalent received by the workers can only be estimated in this case because there are uncertainties regarding: (1) general exposure rates in the shielded portion of the building where they were working (no information was provided); and (2) the workers' proximity to the drain line at any given time. A constant one-foot distance was chosen to simplify the calculation. Given these uncertainties, the whole-body doses are estimated as follows.

The equation to calculate the external dose equivalent (H) is:

$$H = \text{dose equivalent rate} \times \text{time}$$

Worker "A"

Worker "A" spent an estimated 20 minutes near the drain line. Therefore, the worker received a dose equivalent of:

(60 mrem/hr) *x* (1hr/60 minutes) *x* 20 minutes = **20 mrem**

Worker "B"

Worker "B" spent an additional two minutes near the drain line. The dose equivalent is:

(60 mrem/hr) *x* (1hr/60 minutes) *x* 22 minutes = **22 mrem**

Article 213 and Table 2-1, Summary of Dose Limits, provide the annual allowable dose limits. Considering only the dose received from external exposure to the drain pipe, the DOE annual whole-body limit of 5 rem was not exceeded by either worker. Worker "A" received an external dose of 20 mrem; Worker "B" received 22 mrem externally. No information was provided in the scenario as to whether any facility administrative control limits (ACLs) were exceeded. Certainly, the ALA philosophy suffered in this instance; therefore, an ALARA review should be initiated to prevent this situation in the future.

4. SUGGESTED ADDITIONAL READINGS AND/OR COURSES

Courses

- DOE/EH-0450 (Revision 0), *Radiological Assessors Training (for Auditors and Inspectors) - Fundamental Radiological Control,* sponsored by the Office of Defense Programs, DOE.
- *Applied Health Physics* -- Oak Ridge Institute for Science and Education.
- *Radiological Worker Training* -- DOE-EH.
- *Radiological Control Technician Training* -- DOE-EH.
- *Radiation Protection General Technical Base Qualification Standard Training* -- GTS Duratek.